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**B-52 AND KC-135 MISSION QUALIFICATION AND
CONTINUATION TRAINING: A REVIEW AND ANALYSIS**

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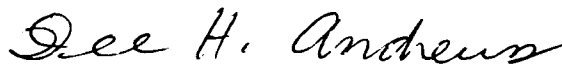
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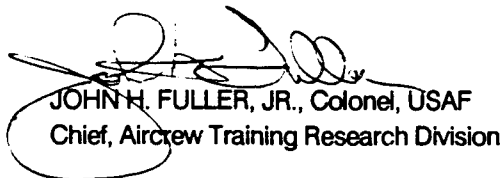
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13. ABSTRACT (Maximum 200 words) This report documents the findings of a review and analysis of mission qualification and continuation training for B-52 and KC-135 aircrews. The effort addressed unit perceptions of the capabilities of formal school graduates, training requirements, training resources, aircrew and training system evaluation, and management. In addition to providing extensive descriptive and analytical information about the operation of a large aircrew training system, the report includes as major findings: (a) the need to clarify initial qualification training requirements; (b) evidence of widespread support for recent initiatives regarding training of tactics and warfighting skills, and a corresponding need for increased attention to the design and implementation of this training; (c) the necessity for effective and efficient allocation of training resources across the continuum of training; (d) the need to develop improved methods for evaluating individuals and aircrews—especially in terms of combat skills—and the training system as a whole; and (e) the need for an improved mechanism to manage the training requirements process throughout the training system. Recommendations are provided for research and development in several key areas.			
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PREFACE

This work was performed in support of the Aircrew Training Research Division, Human Resources Directorate, Armstrong Laboratory (formerly the Operations Training Division, Air Force Human Resources Laboratory), under Work Unit No. 1123-03-83, Flying Training Research Support and 1123-31-04, C-130 Aircrew Training System Research Program. The report documents a field study and analysis of B-52 and KC-135 training at four operational units, Headquarters Strategic Air Command (HQ SAC), and the 436 Strategic Training Squadron (STS). The initial purpose of the effort was to determine gaining unit perceptions of the capabilities of graduates from the B-52 and KC-135 Combat Crew Training School (CCTS), or the formal school. The intent was to provide this information to follow-on contractors prior to their execution of a front-end analysis directed toward improving the CCTS program. While in process, our effort was expanded to include a more extensive review of B-52 and KC-135 mission qualification and continuation training per se.

In addition to being a presentation of findings and issues in B-52 and KC-135 aircrew training, the contribution of this study is the communication of significant information about the domain of aircrew training in general. The issues discussed are representative of those likely to be encountered across aircrew training systems. This has indeed been confirmed in substantive conversations with individuals involved in aircrew training from a variety of weapon systems and major commands. One can also validate this conclusion by comparing the present report and the results of other front-end analyses of aircrew training systems (e.g., Fishburne, Williams, Chatt, and Spears, 1987). Some of the major variables considered in our report are training requirements, training resources and regimens, aircrew and training system evaluation, and management. A resounding theme is that these variables must be considered in relationship to each other, i.e., as an integrated system. It is this system perspective, above all, that we wish to communicate to training designers, managers, and decision makers at all levels. We have tried to do this, in part, by providing illustrations of what can happen when the systems approach is not practiced, or when there are lapses in "organizational vigilance" with respect to the entire continuum of training. The reader's attention is directed in particular to discussions of training requirements and the allocation of training resources.

This report is especially offered to workers in the aircrew training research and development (R&D) community, who have neither the opportunity nor the time to conduct field studies of aircrew training systems on their own. Developing an understanding of aircrew training operations, by whatever means, provides a critical context within which to place one's own R&D efforts. In the report we have also identified some high-payoff areas for follow-on R&D programs. The astute reader will, of course, be able to extract others from the study results. By logical extension, operational training and evaluation needs provide the anchor or foundation from which to build an aircrew training R&D program.

This study also contributes to the methodology of conducting front-end analyses of aircrew training systems. The work is intended to convey a sense of the multiplicity of sources where one might look to find information about how aircrew training is generated, developed, conducted, evaluated, and supported. The problem for the front-end analyst, particularly if from outside the organization (e.g., a contractor), is that "training" permeates much, if not most, of the activity in an operational unit, and then extends upward through the chain of command; it is a ubiquitous phenomenon. Exploring and then mapping the training network can be likened to the activity of a detective. The present study by no means provides an exhaustive list of "leads," but we hope that the ones offered here will help others.

The authors wish to acknowledge the substantial contributions of Dr. Robert Nullmeyer, Aircrew Training Research Division, who was involved in the planning of our efforts, and who

provided guidance and support throughout the study. Lt Col Lee Johnson, formerly of HQ SAC/DOTPI, and Lt Col Bob Bradeen, 15 AF/DOTT, kindly coordinated our efforts with the units and the 436 STS. They were also instrumental in the SAC review of this document, although they are not responsible for the content. We wish to express a note of thanks to the nearly 275 aircrew members, training managers, and training support personnel we interviewed during April through August, 1987. During that time period, Dr. Philip Bruce was employed by the University of Dayton Research Institute, and Dr. Thomas Killion was employed by the Aircrew Training Research Division.

B-52 AND KC-135 MISSION QUALIFICATION AND CONTINUATION TRAINING: A REVIEW AND ANALYSIS

SUMMARY

This report documents the findings of a review and analysis of mission qualification and continuation training for B-52 and KC-135 aircrews. The initial purpose of this effort was to determine the units' perceptions of the capabilities of graduates of the B-52 and KC-135 Combat Crew Training School, or formal school. The focus of the effort was later expanded to include a study of mission qualification and continuation training per se. Interviews were conducted with aircrews, training managers, and training support personnel from four operational units, Strategic Air Command Headquarters, and the 436 Strategic Training Squadron. In addition, key regulations were reviewed, along with organizational charts, training reports, schedules, and other archival data which relate to training and evaluation processes.

Foremost among the themes which emerged is the need to establish a mechanism for developing and coordinating training requirements across the entire continuum of training. Although recent emphases on tactics and warfighting skills are welcomed by the crew force, close attention must be paid to the design, development, and implementation of this training—especially the availability of important training assets such as weapon system trainers. Methods for achieving the effective and efficient allocation of training resources across the system are necessary. The current flying schedule is overburdened, and some training requirements could be downloaded to alternative devices. The development of better methods for evaluating aircrews, especially on combat skills, and for evaluating the training system as a whole will promote improved training and enable the Command to document more effectively the benefits of resource expenditures. Research and development are recommended in several key areas.

INTRODUCTION

The purpose of this report is to document the findings of a review of mission qualification and continuation training for B-52 and KC-135 aircrews within the Air Force Strategic Air Command (SAC). The initial objective of the review was to gain a better understanding of operational unit training policies and practices, in order to identify areas and issues which should be considered during the front-end analysis of the B-52/KC-135 Combat Crew Training School (CCTS) Modernization Program. Prior to the initiation of data collection, it became apparent that much of the information to be obtained would also have implications for SAC's current mission qualification and continuation training programs, as well as for new initiatives such as the Airmanship Program, tactics training, and Aircrew Training 2000. As a consequence, it was decided to broaden the focus of the study to include greater emphasis on in-unit training policies and practices.

It should be noted that the review included a representative, but limited, sample of all B-52/KC-135 operational units. In addition, the review was conducted during a period when the SAC aircrew training system was in a period of transition with the introduction of the Airmanship Initiative, increased emphasis on conventional missions and tactics training, a shift in the role and functions of the 1st Combat Evaluation Group (1CEVG), and ongoing revisions of SACR 60-4 and the SAC 51-series regulations. Despite these caveats, there was a high degree of consistency across units and organizations within units with respect to the key issues identified and discussed in this report.

Background

Many current aircrew training programs have been characterized as being largely lock-step, labor-intensive, and inefficient. Frequently, these programs are comprised of phases and blocks of instruction that have been independently designed and developed in relative isolation from the system as a whole. As a consequence, there may be gaps or unnecessary redundancies across phases and blocks of training. It is often the case that the actual aircraft, that is usually the most costly resource, is used to compensate for instructional deficiencies that could have been corrected in much less expensive ways. In addition, because of the lack of integration across components and subsystems of the total system, current programs are often relatively inflexible or inefficient in adapting to changes such as those imposed by modifications in operational requirements, variations in student flow, and the introduction of new training technologies.

As a result of such limitations, there is a growing recognition within the Air Force, as well as the other military services, of the need to design, develop, evaluate, and operate aircrew training programs as *total* systems, rather than as relatively disjointed sets of components or phases of training. The primary thrust of this approach is to optimize the performance of the system as a whole, through the effective integration of key design components and available resources. Currently, the Air Force is involved in the development or operation of a number of aircrew training programs from a total training systems point of view. Virtually all of these programs are being developed and operated with some measure of contractor support. For example, one of the major new initiatives is the C-130 Aircrew Training System (ATS), which is currently being developed for the Military Airlift Command (MAC) at Little Rock Air Force Base (AFB), Arkansas, under a contract with the CAE-Link Corporation. In addition to the C-130 ATS, each of the Air Force major commands is also planning, developing, or operating a number of contractor-supported aircrew training programs. Some examples of these programs are the E-3A, F-15, and F-16 (Tactical Air Command); the C-5, C-141, and C-17 (MAC); and the KC-10 (SAC).

During the past 3 years, SAC has been planning and defining a variety of new programs to improve and upgrade its overall aircrew training system. Included among these programs are the Annanship initiative, tactics training, Aircrew Training 2000, and B-52/KC-135 CCTS Modernization. The general goal of this latter program is to modernize the B-52/KC-135 CCTS of the 93 Bombardment Wing (BMW) at Castle AFB, California. The CCTS provides initial qualification training for all B-52 and KC-135 aircrew members, and it also conducts pilot/navigator upgrade and requalification training. The current CCTS program is very labor-intensive and follows a traditional block format of academic, simulator/training device, and flight training phases. The CCTS Modernization Program has been structured as a two-phase effort consisting of a front-end analysis, followed by development, implementation, operation, and maintenance. This "modernization" is to be accomplished through the application of advanced concepts in training development, delivery, and management technology.

Board of Visitors Review. During the period of 4-7 August 1986, the third Board of Visitors (BOV) conducted a comprehensive review of the CCTS training program at Castle AFB (BOV, 1986). This review was conducted by a group of outside training experts commissioned by the Commander of the 93 BMW. During the course of their review, the BOV was briefed on the goals and objectives of the proposed B-52/KC-135 CCTS Modernization Program. The BOV *unanimously endorsed the program*, stating that it was "timely and conceptually sound." They also observed, with respect to the current program, that "In spite of needs analysis visits and external evaluation questionnaires, there is no integration of continuation training with initial qualification training." On the basis of this observation, they made the following recommendation:

"The contract for the CCTS Modernization Program should look at SAC's entire training program as a system and require that the training system for SAC B-52/KC-135s be a "cradle to grave" training system approach. Under this approach, analysis of the continuation training requirements would help better define CCTS training goals" (BOV, p. 7).

The BOV further recommended that an approach such as that proposed in the C-130 Model Aircrew Training Study (MATS) be used in the B-52/KC-135 Modernization Program (see Fishburne, Spears, & Williams, 1987; and Fishburne, Williams, Chatt, & Spears, 1987).

Armstrong Laboratory Tasking. A meeting of the CCTS Modernization Working Group was held at Castle AFB during the period from 30 March to 3 April 1987. One of the major objectives of this meeting was to prepare a plan defining the actions to be accomplished by the Air Force prior to award of the Phase 1 front-end analysis contract. The primary product of this meeting was a draft of the "Step One Management and Support Plan," dated 3 April 1987. This plan listed a number of in-house problem analysis and planning activities to be completed. The Aircrew Training Research Division of the Armstrong Laboratory Human Resources Directorate (AL/HRA), assisted by the University of Dayton Research Institute (UDRI), was tasked to support several activities identified in the plan, including the conduct of a gaining unit survey and an information flow analysis. The objective of the gaining unit survey was to "address CCTS in the context of a total training continuum that includes continuation training." The specific issues to be considered were identified as "the current match between gaining unit needs and CCTS outputs, the ideal CCTS product as described by gaining unit personnel, and the need for modernized continuation training." These general requirements were used as the guidelines for defining the specific objectives of this study, which are listed in the following section.

Objectives of this Study

The major objectives of this study were as follows:

- a. Obtain gaining unit comments concerning the quality of CCTS graduates and identify areas for improvement, including additional training tasks.
- b. Review current mission qualification and continuation training processes and identify common issues and concerns, including those that might impact CCTS modernization.
- c. Assess the impact of the major new training initiatives (e.g., airmanship and tactics) on the units, and identify the implications for CCTS and continuation training.
- d. Provide recommendations for specific areas and issues to be considered by SAC and the Phase I contractor with respect to CCTS Modernization and in-unit training programs.
- e. Identify training system problems and issues which might form the basis for the development of a high-payoff field research program.

Organization of Report

This report consists of four major sections. Section I, Introduction, provides some of the background information on what led to the initiation of this effort and identifies the study objectives. Section II, Methods, describes the study approach, the organizations/units visited, and the kinds of data collected. Section III, Findings and Discussion, consists of seven

subsections which present and discuss the categories of findings and observations. Subsection A, Impacts of Phase I Training, discusses some of the capabilities and limitations of CCTS graduates as perceived by the various gaining units. It also considers some of the issues related to CCTS versus in-unit upgrade training and the utilization of First-Assignment Instructor Pilots (FAIPS). Subsection B, General Description of Phase II and III Training, summarizes the mission qualification and continuation training processes within a typical bombardment wing, as well as the training functions and responsibilities at various levels within SAC. Subsection C, Combat Training, focuses on issues that impact the tactics and conventional training initiatives. Subsection D, Training Methods and Media, identifies some of the capabilities and limitations of the methods and media available for flight, simulator, and academic training at the unit level. Subsection E, Evaluation, addresses the evaluation of individuals and aircrews in mission qualification and continuation training, as well as the evaluation of unit training programs. Subsection F, General Issues discusses some general training management issues, such as requirements, training management support, and personnel, all of which impact the effectiveness and efficiency of the SAC aircrew training program. Subsection G, Research and Development, identifies a number of potentially profitable research thrusts which address some of the issues identified during the review. Finally, Section IV, Conclusions and Recommendations, summarizes some of the key findings and provides recommendations for follow-on actions.

METHOD

The sites for information collection are listed in Table 1. These included SAC Headquarters (HQ SAC), the 436 Strategic Training Squadron (436 STS), four operational wings with B-52 squadrons, and one KC-135 Air Force Reserve (AFRES) unit. Active-duty KC-135 squadrons were co-located at wings with bomber squadrons, with the exception of the 320 BMW, Mather AFB, California.

Several factors dictated the selection of these sites. HQ SAC was visited to obtain a top-down view of training in the Command: how training is organized and how it is designed to operate in the units, including the role of HQ SAC. The 436 STS is the Instructional Systems Development (ISD) focal point for the Command. It also develops training materials for mission qualification and continuation training and is responsible for evaluating the courseware that it develops. Criteria used in selecting operational units were (a) G-Model and H-Model B-52 bases; (b) approximately one-half the units have a B-52 weapon system trainer (WST) on-site; (c) a fairly broad range of mission types, including Emergency War Order (EWO) and conventional taskings; (d) small and large operational units; and (e) units from 8th and 15th Air Force. The 161 Air Refueling Group was visited to determine the training procedures followed by AFRES units.

The focus of information collection at HQ SAC was primarily on the Directorate of Training (HQ SAC/DOT), but the Tactics Training Division in the Directorate of Electronic Combat, Test and Tactics was also visited, in order to obtain information about the recent tactics training initiative within the Command. Offices/personnel visited at HQ SAC, the 436 STS, and each of the four active operational units are presented in Tables 2, 3, and 4, respectively.

Extensive interviews were conducted with key personnel in all the offices visited. Early in the study, interviews were structured in a very general manner. As trends emerged, a similar line of inquiry was pursued at other units for purposes of verification. Most of the questions remained sufficiently open-ended, however, to encourage new leads or divergent trends in the descriptions of training and the identification of problem areas. The investigators also reviewed SAC regulations, Command and wing organizational charts, training forms, Training Review Panel reports, schedules, briefing materials, and other archival data, to provide a more comprehensive description and understanding of training and evaluation. The 51-series regulations for both aircraft were studied prior to the visits, as they provide the basic framework for aircrew training.

TABLE 1. VISITATION SITES FOR INFORMATION COLLECTION

Strategic Air Command Headquarters; Offutt AFB, NE

436 Strategic Training Squadron; Carswell AFB, TX

320 Bombardment Wing; Mather AFB, CA

2 Bombardment Wing, 1 Combat Evaluation Group, and
KC-10 Program; Barksdale AFB, LA

410 Bombardment Wing; K.I. Sawyer AFB, MI

379 Bombardment Wing; Wurtsmith AFB, MI

161 Aerial Refueling Group; Sky Harbor Airport, Phoenix, AZ

**TABLE 2. OFFICES VISITED AT STRATEGIC AIR
COMMAND HEADQUARTERS¹**

Directorate of Training (DOT)

Training Plans Division (DOTP)

Programmed Flying Training Branch (DOTPF)

Training Systems Development Branch (DOTPI)

Aircrew Training Devices Branch (DOTPD)

Aircrew Training Division (DOTT)

Tactical Aircrew Training Branch (DOTTA)

Tanker Aircrew Training Branch (DOTTK)

Directorate of Electronic Combat, Test and Tactics (DOJ)

Tactics Division (DOJT)

¹HQ SAC was reorganized after these visits were conducted.

**TABLE 3. OFFICES VISITED AT
463 STRATEGIC
TRAINING SQUADRON**

Squadron Commander (CC)

Training and Education Branch (DOTE)

Media Products Branch (DOTV)

Bomber Training Branch (DOTB)

Tanker Training Branch (DOTK)

Technical Applications Branch (DOTC)

**TABLE 4. OFFICES/PERSONNEL VISITED AT
FOUR OPERATIONAL UNITS**

Chief of Aircrew Scheduling (DOT)
Operations Systems Management Branch (DOTF)
Scheduling (DOTB/K)
Training Flight (TF)
Bomber Navigation (DONB)
Standardization/Evaluation Division (DOV)
Tactics (DOJ)
Bomber and Tanker Squadrons
Squadron Commander/Operations Officer
Aircrews

FINDINGS AND DISCUSSION

A. Impacts of Phase I Training

The training continuum for B-52 and KC-135 is composed of three phases, and whether intentional or not, each of these phases has an impact on the others. This is most apparent with respect to CCTS graduates when they arrive at the gaining unit. The units then have the responsibility for converting the graduates into mission-ready crewmembers. They must use their own training resources, which are based primarily on Phase II and Phase III training requirements. The efficiency with which CCTS graduates become combat-capable crewmembers is determined not only by the Phase II and Phase III training programs at gaining units, but by the knowledge and skills which the graduates have learned and retained from Phase I. Any deficiencies must be remediated at the gaining unit, and the resources which are devoted to this task consume some portion of the resources which would alternately be devoted to Phase II and Phase III training. Accordingly, the units have a vested interest in the entry knowledge and skill levels of CCTS graduates.

Related issues arise with regard to upgrade training and the introduction of FAIPs into the crew force. Upgrades can be accomplished locally at the operational unit, but this consumes significant resources. There are also some tradeoffs with respect to the quality of training, standardization, and other factors that must be considered in determining where upgrade candidates will be trained. With regard to FAIPs, there are some unique issues relating to their ability to operate in the multicrewmember environment, given their primary experience in trainer aircraft. Again, providing them with special training at the units to compensate for this lack of experience has resource impacts. The following sections highlight specific issues concerning CCTS graduates, upgrade training, and FAIPs.

CCTS Graduates

In general, the units expressed satisfaction with the product of the CCTS. However, they also readily acknowledged that the 93 BMW has a difficult job of turning out a product that is fully acceptable to all units, particularly since the range of mission taskings is increasing throughout the Command. When pressed to critique CCTS graduates, a number of respondents contradicted one another. For example, some suggested that the CCTS should emphasize greater proficiency in aircraft operation, whereas others suggested that the CCTS should turn out a graduate who is more proficient in mission skills. Such contradictions were interpreted as reflecting the lack of a commonly accepted definition of what the CCTS training requirements are or should be. Without such a definition, the units differ in their desires as to what training requirements they would have the student accomplish at CCTS. The CCTS cannot address all their needs, particularly under current time constraints; so, they differ (sometimes significantly) on how the CCTS resources should be spent. This is largely because the units must transform the CCTS graduate into a combat-ready crewmember. The better prepared the student is at CCTS, the fewer resources the units need then invest in this process. Given limited resources and time of their own, the units would prefer to have a student who has already acquired certain critical skills. Despite some apparent contradictions from some of the respondents relative to CCTS training requirements, some common themes did emerge. These can be categorized into individual crewmember skills and knowledge, combat mission training, and crew operations. Each is discussed below.

Individual Crewmember Skills and Knowledge. The units indicated that CCTS graduates at all crew positions generally have an acceptable level of skill in basic equipment operation. However, graduates are often lacking in detailed aircraft system knowledge, situational awareness, and problem-solving skills which would result in more adaptive, independently functioning crewmembers. As colorfully described at one unit, in the "old days" the new crewmember could depend on the "old heads" to provide them with training on the details of system operation and problem solving. Unfortunately, with major changes in the equipment and the general reduction in experience levels in the Command, that experience base has been substantially reduced. As a result, new crewmembers seem to be much more system-dependent and less adaptable to unusual circumstances.

This problem was mentioned frequently with regard to navigators. A degradation has been noted in basic navigation skills, including celestial navigation. Navigators seem to be more equipment-dependent with regard to automated mission planning and on-board operations. They lack the ability to adjust to equipment malfunctions via backup modes of operation or inflight mission changes that require significant recomputation. The units have instituted a variety of programs to address these problems. Such programs include forcing the crew to accomplish portions of the mission planning manually and having the navigator team use degraded modes of operation.

A lack of understanding of mission operations, as opposed to pure systems operations, was frequently mentioned as a problem for incoming electronic warfare officers (EWs). The general consensus was that the EW took the longest of any of the crewmembers to achieve true mission capability. This is in part due to the increasing emphasis on tactics within the Command and the consequent focus on the EW as the source of tactics knowledge. Another factor has to do with the fact that the EW and the gunner are unique positions on the aircraft. While the copilot is in some sense an apprentice aircraft commander and the navigator an apprentice radar navigator, the two defensive positions operate independently of either supervision or a role model, unless there is an instructor present. Although an experienced EW may aid a novice gunner, and vice versa, the two are, in essence, flying solo at their respective positions. As a result, they may need to be more thoroughly trained at CCTS than either the copilot or the navigator.

Additional comments were made concerning a variety of individual skills and tasks. One unit noted that copilots have shown deficiencies in emergency procedures, traffic patterns, and landings. Another suggested that B-52 crews receive too much training in missile launches and low-level bombing. Several people suggested adding night/mountainous terrain avoidance qualification and heavyweight refueling for B-52s at CCTS. Some KC-135 units mentioned deficiencies in boom operator skills, and one unit identified a problem in the area of cargo loading. These are all possible areas for consideration, but again they probably reflect the lack of a clear understanding of what CCTS training requirements are or should be. If such a definition can be achieved within the Modernization Program, then it can be determined what tradeoffs should be made in terms of training emphases.

The more general problem of the lack of in-depth system knowledge and skills is clearly an area for concern, particularly in light of decreasing experience levels within the Command. To address this, a review of the current instructional objectives should be accomplished, to determine whether they support an adequate level of systems understanding. If they do not, the objectives should be modified so that CCTS will provide adequate system knowledge and a conceptual background to allow students to adapt to unusual circumstances, anticipate effects on mission operations, and interact appropriately with other crewmembers.

Combat Mission Training. One of the key concerns at the units is how to qualify new crewmembers in areas such as conventional operations and tactics, as well as in the unit EWO mission. The wings have limited resources for accomplishing this additional training in light of existing training requirements, alert requirements, additional taskings (e.g., higher-headquarters-directed (HHD) activities), and so on. This results in a substantial lengthening of the overall qualification process. The problem is particularly acute at those wings which must travel to obtain WST training, because parts of this training are required for both EWO and tactics qualification, and visits to the WST can be infrequent due to factors such as scheduling conflicts and instructor availability. The bottom line is that the combat qualification process at the wings could be substantially reduced by increasing the degree of combat mission training the student receives prior to arrival at the gaining unit. Several alternatives for implementing this were suggested, and each should be considered in relation to the CCTS Modernization effort and the overall SAC training process.

One alternative would be to establish a centralized, combat-mission qualification school; such training could be completed immediately after CCTS. This would require major resource reallocations, but it would relieve problems that the wings have in providing the necessary qualification training in a relatively short period of time. This would also allow Castle AFB to focus solely on qualifying the student in basic aircraft skills. The second option would be to integrate additional training into the Castle AFB curriculum, in areas such as threat knowledge, basic tactical skills, and conventional operations. This would include training in the WST and the aircraft, as well as academics. It would probably require, however, some lengthening of the program at Castle. Although there have been some recent initiatives at Castle in these areas, it was too early at the time of our visits for the wings to assess the effects and determine if the improvements are sufficient. These steps are generally regarded as positive, but they will need to be investigated further by follow-up visits at the units. A third alternative would be to focus initial qualification training on the conventional rather than the EWO mission. The conventional role is generally regarded as more complex, and it may be easier to transfer to EWO from conventional than vice versa. However, this option would certainly require modifications to the WST and other training devices, in order to provide practice on the necessary equipment. It might also require more training time at Castle to qualify in additional skill areas such as cell-formation flying. A final alternative, considered as a minimal option by most of the units, would be to include some of the generic EWO mission certification training at CCTS. This would introduce some efficiencies into the certification cycle at the units and thereby reduce its overall length.

Crew Operations. Although the major goal of CCTS is to develop individual skills, there is a noticeable period of time before a new crewmember understands the coordination and pacing involved in functioning as part of a crew. Even though the aircraft commander is the designated leader, each member of the crew may take on the role of functional leader during activities that rely on their expertise. In CCTS classes, the Pilot Upgrade aircraft commander and the Navigator Upgrade (NUP) radar navigator have had experience in the B-52 and generally know what to expect. The other four crewmembers have never been part of an operational crew, and it takes some time for them to understand their roles. CCTS graduates require an appreciation of the shift in functional leadership and pacing of activities required when the crew functions as an integral unit. They receive some introduction to this in the WST and the aircraft while at the 93 BMW, but they are mainly concerned with becoming proficient in their own crew positions.

One possible approach to facilitating the transition to crew operations would be to introduce at least a limited version of Aircrew Coordination Training (ACT) at CCTS. ACT is related to the civilian airlines' Cockpit Resource Management training programs, the focus of which is on crew interactions and problem solving. It addresses such topics as management strategies, leadership/followship, conflict resolution, interpersonal communication, and critique. Such concepts could be introduced in the academic phase of CCTS and reinforced during the simulator and flight phases. In that SAC is planning to introduce ACT on a more general basis throughout the Command (see Section G below), it would seem very natural to introduce such concepts in CCTS.

Upgrade Training

Currently, the 93 BMW cannot meet all the B-52 and KC-135 upgrade quotas required for the Command. Therefore, some upgrades must be accomplished locally. A number of factors are considered in determining which crewmembers are sent to CCTS for the few slots available. There are some positive aspects of sending an upgrade student to CCTS, rather than upgrading him locally. A temporary duty (TDY) assignment is often perceived as a reward. The flying hours expended for upgrades at CCTS also do not come out of the unit flying hour budget. Further, students at CCTS are not burdened by additional duties. On the other hand, units indicated that if a navigator or pilot scheduled to upgrade is perceived as weak or requires special handling, they tend to send him to CCTS. "Hard chargers" tend to be upgraded locally.

Local upgrades also have advantages and disadvantages. Personnel shortages within the unit may require that upgrades occur locally, rather than waiting for a slot at CCTS. But unit instructors conducting local upgrade training also have the flexibility to focus on unit-specific missions. Radar navigators upgraded locally tend to perform better for the first 6 months or so, especially at units with conventional missions. After that, CCTS and local upgrades are about equal. On the other hand, local upgrades do expend unit flying resources and tie up instructor resources.

Standardization and quality control are also issues for local upgrade training, because the syllabus and materials used for training—but not the core requirements—may be developed by the units themselves. One unit did suggest, however, that local upgrades should go to CCTS for academics only. Some units actually use the academic material from CCTS for local upgrade training. One potential solution to this problem would be for the CCTS to provide a standard unit upgrade syllabus to which the units could add extra material of local importance. Many of these issues have been resolved, however, in that the Command has recently determined that pilot upgrades will go to Castle for academics only—prior to flight training, which will be conducted at the local units.

Regardless of whether the decision is to upgrade locally or at CCTS, this training must account for the lower experience levels of current candidates. NUPs used to be captains with 1,000 hours; now they are lieutenants with 400 hours. The entire crew force is younger and

less experienced than the population considered during the initial design of upgrade training at CCTS. This is another factor that needs to be addressed in the CCTS Modernization Program.

First-Assignment Instructor Pilots

First-Assignment Instructor Pilots with 1,000 hours of flight time and 1 year of experience as an instructor in Undergraduate Pilot Training (UPT) meet the minimum entry requirements for initial qualification as B-52 or KC-135 aircraft commanders at CCTS (SACR 51-52 and SACR 51-135). Following graduation, they generally occupy the left seat of their respective aircraft at operational units. In the case of the KC-10, however, the authors were informed that FAIPs are trained as copilots and serve approximately 1 1/2 years in the right seat before being upgraded to aircraft commander. The typical UPT graduate spends 5 to 6 years in the right seat of the KC-10 prior to upgrade. The FAIP policy in the KC-10 community was said to be based on the general assumption that despite their flight time and instructor experience "the FAIP 'new hires' have a lot to learn about both the aircraft and the mission before they are ready to assume command."

During this review, several of the personnel interviewed expressed the opinion that B-52/KC-135 FAIPs also had a lot to learn following graduation from CCTS. It was noted that new FAIPs tended to be relatively weak in crew coordination and pacing skills, as well as their general understanding of SAC operational procedures. One of the current practices to compensate for this lack of experience is to have qualified instructors fly periodically with the FAIP aircraft commander during the first 6 months of the initial operational assignment. However, it was recommended by some that it might be even more desirable for all B-52/KC-135 FAIPs to serve mandatory apprenticeships as copilots prior to becoming fully certified aircraft commanders. In addition, it might also be desirable to provide the new FAIP aircraft commanders with a specially tailored short course in aircrew coordination training during the early stages of their first assignment, in order to promote rapid development of crew coordination and communication skills.

B. General Description of Phase II and Phase III Training

The remainder of this report is largely concerned with mission qualification and continuation training, although implications for training and evaluation at the CCTS are also discussed. The purpose of this particular subsection is to describe mission qualification and continuation training within a typical bombardment wing. It also provides a general context for the remaining subsections, which treat various training topics in greater detail.

It is important to understand that other organizations within the Command substantially affect the training at individual units. Significant training functions occur at HQ SAC, primarily in the Directorate of Training (HQ SAC/DOT); 8th and 15th AF; and the 436 STS at Carswell AFB, Texas, which is supervised by the HQ SAC/DOT. Briefly, HQ SAC/DOT has system-wide training responsibilities that affect all B-52 and KC-135 units. Some of the main functions include program development for the CCTS and continuation training, ensuring that aircrew training devices meet training requirements, and monitoring training device utilization for contractual purposes. In addition, HQ SAC/DOT has general responsibility for the operation of continuation training, and it authors the principal regulations that govern training and evaluation throughout the Command. The Numbered Air Forces (NAFs) can create additional programs and training requirements that the units must implement. The 436 STS is responsible for developing, updating, and evaluating some of the courseware used for ground training at the units, and it is the focal point for ISD within the Command.

Aircrew training operations at the unit level are performed by the various divisions and flying squadrons under the Deputy Commander for Operations. Principal among these are Aircrew Scheduling (DOT), Operations Plans (DOX), Standardization/Evaluation (DOV), Operations (DON), Tactics (DOJ), and the tanker and bomber squadrons, including the squadron Training Flight. The "training side" of the wing must coordinate their activities with the "maintenance side" of the wing, which, under the Deputy Commander for Maintenance, has responsibility for generating flying sorties. The B-52 and KC-135 aircraft are the primary physical resources for completing the training requirements. Training is developed, scheduled, verified, and tracked primarily by the unit DOT, in coordination with the tanker and bomber squadrons and other appropriate divisions. As a result of these interactions, aircrews consume the annual flying hours allocated to the wings for training. The management of training is, in large part, the art of matching the proportion of training requirements completed to a comparable proportion of flying hours consumed, per unit of time.

Oversight of training at the units occurs through a variety of means. There are review and reliability panels, which include the Standardization/ Evaluation Review Panel and the reliability panels coordinated by DON and DOJ, which monitor bombing/navigation and electronic countermeasures (ECM) activity, respectively. These panels are integrated into the Training Review Panel, which also includes the Combat Crew Capabilities and Utilization Review Panel. The Training Review Panel is conducted quarterly, whereas the other review and reliability panels may be conducted monthly. Significant mission activities, including bombing and ECM, are reviewed daily by the Wing Commander or Vice Wing Commander at "Stand Up." Aircrew resource and availability information, including bomber and tanker mission-ready crew status, is reported daily in the Training Measured Area of the *Status of Resources and Training System* report, formerly the *Unit Reporting of Resources and Training Status* report.

SACR 51-52 and SACR 51-135 are the principal regulations that set out the flying training programs for the B-52 and KC-135 units. Ground training requirements are also specified in SACR 50-24. As mentioned previously, 8th and 15th AF, HQ SAC, and the local units themselves may impose additional requirements, most of which must be completed within the same unit-level resource limitations, such as the annually allocated flying hours. Though regulations set out the specified aircrew training requirements, they are also accounting devices from which flying hour budgets can be structured for each fiscal year.

Aircrew training is more, however, than the ground and flying training activities set forth in the regulations and directives. Training, as considered in this report, includes all those ground and flying activities by which aircrews acquire, perfect, and maintain the knowledge and skills that may be exercised in real operational missions. The Airmanship Program, tactics training, and other programs are not necessarily specified as part of the 51-series regulations, yet they are important parts of the total B-52 and KC-135 aircrew training program. The conception of training advocated here also includes various exercises such as Red Flag; deployments; competitions such as Bombing/Navigation Competition; and assessments such as Operational Readiness Inspections (ORIs) and Global Shield. All of these activities have training value in that they contribute to a state of readiness, and training resources are expended to prepare for them. By engaging in these activities, aircrews perform critical mission skills that are presumed to be of direct benefit in operational missions. This larger conception of training has additional implications, however, in that all training activities must be planned as part of a total system.

SACR 51-52 and SACR 51-135 set out Phase I, Phase II, and Phase III training requirements for all bomber and tanker crew positions. Phase I training was discussed in the previous section of this report. Phase II Emergency War Order (EWO) mission qualification training commences within 7 days after graduates of the CCTS program arrive at gaining units, and it must be completed within 90 days. This training is designed to produce a mission-ready, combat-capable crewmember, who shares alert duties with others in the mission-ready crew force. Alert requirements, the first of which is often scheduled in advance for new crewmembers, can serve

as an inducement for the timely completion of Phase II EWO training. Critical vacancies on existing crews also provide incentives for early completion of mission qualification training.

Prior to arrival at gaining units, graduates may have attended survival training at Fairchild AFB, Washington, or they may have taken leave for a period of time. The time lag between Phase I and Phase II training may, in some cases, be lengthy enough to produce decrements in the retention of flying knowledge and skills acquired in Phase I training. Units surveyed attempt to arrange the first flight for new crewmembers as quickly as possible, in order to prevent or reduce the amount of regression in proficiency gained at the CCTS. Currency requirements must also be met within 45 days after the completion of initial qualification training. Difference training (B-52H Model), if required, may be conducted concurrently with mission qualification training.

The B-52 and KC-135 Training Flights manage and coordinate all mission qualification activity for new crewmembers assigned to their respective squadrons. Locally developed training accomplishment reports are used to track the completion of all ground and flying training events. These requirements include proficiency and examination items. In practice, Phase II flying training is not a neat, compartmentalized process. Instead, flying training for new crewmembers is superimposed upon a substantial, ongoing training operation. Training slots for new persons must be created from existing flights. In this respect, flying sorties serve multiple purposes: Some crewmembers are completing Phase II training requirements, while others are completing Phase III, or continuation training, requirements. Scheduling assigns an instructor of like specialty to be aboard the aircraft to train candidates while they accomplish Phase II flying requirements. These instructors are assigned from the available instructor pool throughout the wing divisions and flying squadrons. Every attempt is made to minimize the number of different instructors who fly with new crewmembers. Each candidate receives 2 to 3 flights, on the average, during mission qualification training. These flights serve to familiarize them with the geographical area, to train them on local procedures, to teach the SAC way of doing business, and to complete Phase II EWO requirements.

In addition to the application of training resources by squadron Training Flights, the unit DON continues to follow new navigators beyond mission qualification training, and DOJ monitors gunners and electronic warfare officers. The squadron operations officer usually emphasizes certain activities for pilots. Senior crewmembers also provide important sources of instruction for new graduates. The structuring and balancing of a crew is an important factor in the continued development of a new crewmember's skills. For example, radar navigators nurture new navigators, and aircraft commanders foster new copilots. Electronic warfare officers and gunners have no such supervision, as there are no senior crewmembers of like specialty on the aircraft during typical daily training missions. The 410 BMW reported that they try to send new tanker people on temporary duty (TDY) assignments, such as Tanker Task Force, for the enhanced training it provides. All these additional types of training or monitoring may continue to be provided for up to 6 months or a year, depending upon demonstrated proficiency levels in job skills by CCTS graduates. Regardless of the level of proficiency attained at the CCTS, most gaining unit instructors report that it takes up to 1 year for new graduates to attain a high degree of independence and proficiency in their respective crew positions.

A vital part of Phase II ground training is the so-called "vault cycle" conducted by DOX. This portion of training includes, but is not limited to, alert procedures, command and control procedures, an exposure to SAC tactics, and the unit mission briefing. It lasts for 2 to 3 weeks, on the average. Phase II trainees must ultimately brief their wing commander, or a designated representative, on the unit mission. At the conclusion of this process, they become EWO-certified.

After Phase II EWO training, crewmembers enter Phase III continuation training. The 51-series regulations define continuation training as that training required to *maintain* the proficiency required to safely operate the aircraft and effectively perform the assigned unit mission(s). Yet,

required to safely operate the aircraft and effectively perform the assigned unit mission(s). Yet, it can be safely assumed that aircrews continue to perfect and refine their flying skills as a function of practice, the level of difficulty of training exercises, and the varied training conditions to which they are exposed. It is reasonable to describe Phase III training as "event-driven," in that its focus is on the completion of specified numbers of 51-series training events. The Operations Resources Management Branch constructs continuation training tables for each individual and aircrew. These tables specify the required numbers of repetitions for each of the training events, per unit of time. The tables factor in crew proficiency levels (ready, experienced, and select), training levels (A, B, and C), and combat readiness levels (emergency combat ready and fully combat ready). Event completion is documented by the aircrews on individual and crew mission accomplishment reports. There is no provision, however, for tracking the corresponding proficiency levels attained while executing the various training events.

Co-mingled with Phase III training is a substantial alert commitment for each of the mission-ready aircrews. Alert duties are 7 continuous days in duration and occur once every 3 weeks, on the average. An alert cycle is followed by crew rest, or "C-square," at the rate of 1/2 day for each day of alert duty. If currency or other specified training requirements are not met, individuals may be assigned to non-mission-ready status. These individuals are not to be placed on alert until the specific training requirements are met. Under these conditions, the Training Flight has the responsibility to remedy any deficiencies (SACR 55-68), so that individuals may be reassigned to mission-ready status in a timely fashion. It should also be recalled that the number of non-mission-ready crews is reported daily to the Wing Commander, SAC, and the Air Staff. Alert cycles commence with EWO studies, or "bag studies," which are conducted at DOX. Testing is conducted on EWO materials during each alert cycle. Changes in EWO procedures and regulations also result in additional ground training requirements for all aircrews, and this training must be scheduled when the changes occur. A wing commander may also require unannounced testing over these materials for his crew force. A simulated launch message occurs sometime during the alert cycle, and aircrews must engage in a specified sequence of activities in response to this message. The alert cycle also provides some of the only time available for completing many of the other ground training requirements, including aircrew training devices.

There has recently been a substantial shift toward the training of B-52 and KC-135 conventional operations. Phase II conventional qualification training typically begins at the completion of Phase II EWO training, although conventional ground training requirements may be completed concurrently with Phase II EWO training at some units. The flying phase of conventional training includes 2 to 3 sorties, on the average. A fairly large percentage of "live drops" of conventional munitions has been introduced into the training regimen at most units, including those which are considered EWO-intensive units. Further discussion and analysis of conventional training are provided in the Combat Training section of this report.

Other aircrew training programs in B-52 and KC-135 units include the Accelerated Copilot Enrichment (ACE) program, in which copilots fly T-37 or T-38 aircraft to build proficiency in piloting skills. The Airmanship Program also focuses on pilot proficiency, and "touch-and-go's" are now a routine training event. The Tactics Training program, discussed further in the section on combat training, is a recent initiative for training the entire crew on various combat tactics. Training for an ORI is also an express part of the unit training program. New crewmembers are first exposed to some of these materials during Phase II EWO training. ORI training may also be conducted during the alert cycle, particularly if there is an impending ORI.

In summary, this combination of training requirements (SACR 51-52 and SACR 51-135 training requirements for conventional, EWO, and other specialized missions; additional requirements levied by HQ SAC and the NAFs; alert requirements; and other training programs, such as tactics, airmanship, and the ACE program) produces a substantial training mission in the units. The execution of these programs requires equally substantial training resources. The ramifications of these and other issues will be discussed in the sections which follow.

C. Combat Training

Recent initiatives within SAC emphasizing conventional qualification and tactics training reflect a renewed emphasis on training of combat capabilities. The goal is to train the aircrew to employ their weapon system resources more effectively to survive enemy defenses and to perform a wide variety of mission taskings. In general, the renewed emphasis on the training of combat skills is enthusiastically supported at the unit level. However, this enthusiasm is somewhat diminished by the current tendency to make mission taskings and resultant skill requirements too varied. As a result, competition for training resources occurs between sometimes conflicting requirements such as the allocation of flight hours to respond to the Airmanship initiative, the Tactics initiative, conventional qualification requirements, and so on. In addition, there is a lack of prioritization among those requirements, leaving the units in a quandary as to which one(s) should receive the most attention and resources. Finally, there is a perception that there is little or no coordination among the agencies that generate the requirements, such as different offices within HQ SAC and the NAFs. In combination, these factors serve to complicate the units' response to initiatives such as conventional qualification and tactics training. These problems must be resolved by better coordination prior to tasking the units, to enable them to develop effective and responsive training programs.

At the unit level, the variety of missions and taskings for which aircrews must be prepared is the key problem. The units feel that basic bomber skills are good, but the wide variety of taskings makes it difficult to maintain proficiency in all areas. The requirement to attain proficiency in a wide variety of tasks limits the amount of practice, and therefore the amount of expertise that can be developed for each one.

Even if mission requirements are limited, the monotony of day-to-day training presents a problem. Flying the same route over and over again provides limited training effectiveness. Aircrews tend to fly the same route, land at the same field, execute the same approach, and so forth. Greater variation in the types of training regimens would likely improve the quality of training, and the quality of the aircrews themselves. Variation in training is a key to combat readiness, as it prepares the aircrews for a wider variety of missions and scenarios. It also contributes to aircrew motivation. The development of the Strategic Training Route Complex (STRC), which will provide a greater variety of routes and scenarios, is a step in the right direction. However, its utility is limited by the frequency of access, particularly for units that must expend significant flight hours simply to reach it. The WST can also provide part of the solution, at least for the B-52. The exemplary efforts at the 379 BMW, where they have developed a variety of tactical WST scenarios, provide an indication of what can be done in this area. Unfortunately, the existence of a single KC-135 WST in the entire Command limits what can be done in this vein for their aircrews.

Within the context of combat training, the recent initiatives concerning tactics training and conventional qualification deserve special consideration. We turn now to some specific issues in these areas.

Tactics Training

In October 1986, the SAC Commander provided direction to train tactics in the field. The intent was to emphasize the concept that combat training involved more than simply getting bombs on target. Rather, it included taking advantage of all the aircraft's resources to survive in the threat environment and get to the target so that weapons could be delivered. This requires the perception that tactics involve the aircrew as a whole, rather than being the responsibility of individual crewmembers such as the EW or the gunner. It includes a move away from the philosophy of tactics as a set of specific procedures and toward the concept of context-dependent responses to threat situations. The Tactics Training program itself emphasizes

integrated crew operations. A large part of this training concerns development of good situational awareness and crew coordination. It enhances their understanding of weapon system capabilities and emphasizes the role of their own judgment in mission performance.

The implementation of the Tactics Training initiative has met with mixed reviews, however. Part of the problem is the limited amount of guidance from HQ SAC relative to the individual unit programs. The units are basically on their own with respect to the development of a Tactics Training program, and their success seems to be correlated with the availability of a WST, which is a critical asset. As a result, there is little or no standardization in the tactics program across units. In addition, there are a number of fragmented parts of the program, such as the SAC Tactics School and the 1CEVG tactics program, with little coordination between them. This leads to some confusion at the unit level as to who has what responsibility for the tactics program. Finally, the lack of specification of tactics training as an event or set of events in the flying training regulations reduces the authority which the unit managers have to implement the program. Lacking specific requirements, they must find ways to integrate such training into existing events, rather than having dedicated sorties.

At the individual units, DOJ is responsible for developing and managing tactics training and for evaluating aircrew tactics performance. Generally, the programs at the various wings have focused on the B-52. In some cases there are no slots in DOJ for KC-135 personnel. Accordingly, the tanker squadrons are responsible for developing their own tactics training programs. Generally, the wings depend upon experienced EWs to develop their programs. To date, standard academic materials to support them, such as coursebooks, have not been produced. Due to limitations in personnel to support development, the 436 STS has not been able to supply appropriate courseware. The 436 STS does produce a set of Electronic Warfare Procedures manuals which could serve as a core for the development of a crew curriculum, but they would require revision, as they are currently written from the perspective of the EW. In addition, course materials developed by the SAC Tactics School might serve as a basis for a tactics curriculum, but the Tactics School is not sufficiently manned to support such development.

On the positive side, the aircrews are enthusiastic in their response to the Tactics Training initiative. In particular, the emphasis on tactics training in the B-52 WST has met with considerable success. The primary benefit of the WST appears to be in integrated crew operations. Training with realistic scenarios teaches such things as good crew coordination and prioritizing of activities. The scenarios developed by 1CEVG for initial tactics qualification receive high marks. There is also general agreement that the tactics training program at the 379 BMW is well organized. They have developed a variety of EWO and conventional WST scenarios. Without exception, instructors state that they can see the improvement in crew performance resulting from this training. When crews are first exposed to tactics training in the WST, they tend to "flail around" to varying degrees. However, additional experience in this environment produces much smoother operations and higher "survival" rates. The beneficial effects of WST tactics training were also mentioned by a staff officer who flew with crews at Red Flag and saw noticeable differences in crews who had received WST training. The only complaint about tactics training in the WST comes from units that do not have their own WST. Basically, they want more of this training. Part of the problem also lies in the availability of qualified instructors to support WST tactics training. The DOJ offices at some of the wings are undermanned, and they have to borrow instructors from other organizations to accomplish the training.

In the flying portions of tactics training, factors such as safety considerations, training restrictions, and crew qualifications make it difficult to get new tactics into the system. The Tactics Division of 1CEVG has been given responsibility for developing and evaluating new tactics. In addition, their tactics team visits units for the purpose of training. During such visits, they have waivers to perform unusual maneuvers and turn off certain aircraft systems as a demonstration to crews. Rather than just weapons delivery, the emphasis is on how to get to the target and evade threats. The team tries to operate as instructors. They provide some ground seminars

and fly with as many crews as possible. They also make recommendations concerning improvements to unit training programs before they leave. The primary limitation of this program is how frequently the tactics team can visit each unit. Because the individual units do not have the same waivers as 1CEVG, the crews themselves cannot practice the demonstrated tactics in the aircraft. This limited exposure, along with the lack of routine practice, may limit the crews' ability to use such tactics in combat situations. In addition, there is a concern among crews that the visits will involve more evaluation than training. This is clearly due to the team's association with 1CEVG; however, eventually this concern may be overcome through experience.

Conventional Training

The Conventional Training/Certification initiative was implemented at about the same time as the Tactics initiative. The purpose of this initiative was to qualify crews for conventional, non-nuclear operations. In B-52 conventional operations, aircraft usually operate in cells and drop iron bombs. Conventional certification involves some academics, but mostly flight training for cell formations, cell air refueling, conventional weapon release procedures, and so forth. The conventional mission seems to require greater crew coordination and is generally considered more complex than EWO training. The consensus was that if a crew could handle conventional operations, they could do the EWO mission.

As with the Tactics initiative, the real problem in the conventional training arena is the competition among requirements. Conventional training has been added with no reduction in existing requirements. Conventional training complicates scheduling, due to the nature of the mission and requirements for crew qualification. Conventional events can also be more difficult to accomplish for SACR 51-52 credit. For example, the lack of an ECM run can disqualify an entire sortie (although this was changed in an updated version of the SACR 51-series regulations which went into effect after the study was completed). It is difficult to maintain crew qualification, to say nothing of proficiency, in all of these areas. Initiatives within SAC toward dedicated EWO or conventional roles for individual units may alleviate this problem.

D. Training Methods/Media

The aircrew training program is generally divided into three areas: flight training, simulator training, and academics. The effectiveness of such training depends on the availability of critical assets (e.g., range systems, simulation devices, and curriculum materials), how these assets are employed, and how they are integrated into an overall training system. Each of the types of training is limited by a number of factors. Flight training is constrained by such factors as safety considerations, route and range systems (e.g., threat simulators) availability, and emissions restrictions. Simulator training is limited by the availability of appropriate devices, currency of these devices, and scheduling constraints. Academic training is affected by the availability of appropriate curriculum materials and the currency of such materials.

Despite these limitations, the units do their best to structure effective training programs and are innovative in their use of training assets in many cases. The most notable example is the application of the B-52 WST for tactics training, particularly at the 379 BMW. They appear to be taking maximum advantage of the availability of the WST and have developed a variety of scenarios for their aircrews. Another promising initiative is the development of computer-based training (CBT) by the 436 STS for a variety of applications. The use of CBT for interactive procedures training on systems operation and malfunctions is critical to fill existing gaps in ground-based training caused by the shortage of simulation devices. CBT can also be used as a tool for introducing aircrews to system changes resulting from hardware/software modifications on the primary aircraft. This is particularly important in light of the usual lag between aircraft modifications and commensurate simulator modifications.

The key issue here is the optimum use of each of the individual training assets. Inflight training appears to be overburdened with a plethora of requirements, some of which could be addressed using alternative media such as the WST or CBT. Given the limitations on flying time, there is a need to use the aircraft more efficiently and fulfill training requirements with lower-cost devices where available and appropriate. Determining which training events are to be accomplished in each medium must take into account factors such as system capabilities, supporting assets (e.g., available routes and threat simulators for flying training), and resource constraints (e.g., the availability of a WST). The following sections highlight issues identified in connection with each of these areas of training. Suggestions are offered for possible solutions to some existing limitations in the training process.

Flight Training

Currently, the aircraft is the primary medium for aircrew training. In the case of the KC-135 and KC-10, their real-world mission (i.e., refueling) is performed on a daily basis. A variety of users compete for the limited amount of available tanker time. With regard to the B-52, a wide variety of requirements (e.g., SACR 51-52 events, HHD events, exercises, and ORIs) compete for the limited amount of flying time. It is difficult for the wings to juggle all of these sometimes conflicting requirements and meet their quotas. For example, there is a move within SAC to foster airmanship; however, tradeoffs in how flight time is used (e.g., touch-and-go's vs. bombing) limit the ability to support it. In general, the units feel that the amount of flying time per se is not the problem; rather, the difficulties are the distribution of time among various events and the limited availability of other resources (e.g., fighters).

Another frequently mentioned problem for flying training is the lack of adequate threat simulators on "backyard" training routes. This limits the ability to get credited training for the EW. The STRC does provide an effective environment, but getting there uses up a significant amount of flying resources for certain units. Similarly, for gunners, there are critical problems in the area of fighter activity. One unit indicated that they accomplish only about 50% of their scheduled fighter events. In addition, gunners want practice in clutter, but the fighters prefer to operate at higher altitudes. Fighters also want to attack head-on, but gunners do not get credit unless tail cone attacks occur. As a result, they have trouble logging enough events. In this case, the requirement appears to be too specific and needs to be more general. One suggestion offered to alleviate the problem was to substitute 1 hour in a fighter area, instead of having more specific requirements. Besides ECM and fighter activity, air refueling for B-52s is another big training problem. Pilots indicated that they need experience under a wider variety of conditions. Tanker hours are very limited; so, they need to be used efficiently.

One possible method for improving the quality of flight training, at least for some crewmembers, is the application of embedded training (ET) technologies. ET involves the use of embedded software, and in some cases hardware, to stimulate on-board systems to provide realistic, in flight sensor cues and responses to aircrew actions. The old Flight Evaluator Operator, which provided in flight practice for gunners, was a rudimentary example of ET. Such training could be effectively applied to threat training for the B-52 EW. On-board software/hardware would provide simulated threat signals to the appropriate displays and would also provide interactive effects of factors such as terrain and simulated electronic countermeasures. Such a system is currently being demonstrated for F-16 training, and it is called the On-Board Electronic Warfare Simulator. It would be much more complicated to apply such technology to the B-52, but the ongoing sensor integration modification to the aircraft could provide a basis for at least a partial ET capability.

Despite the limitations, flying remains the aircrews' primary focus for training. The units appear to use flying time as creatively as possible to maximize crew experience. For instance,

the DON at one wing forces the radar navigator/navigator team to operate the offensive avionics system (OAS) in alternate modes for experience. Although there may be real-world consequences of such degradation, they believe that such practice is important to prepare for a variety of situations. In another case, a unit tries to have at least one sortie per week that lands at a "strange" field. In this way, they accomplish two sorties and the crew's experience base is broadened.

Simulator Training

The B-52 WST has clearly become an integral part of aircrew training. The aircrews like the WST, particularly for practice of integrated crew operations. The use of realistic scenarios teaches good crew coordination, prioritization of activities, and so forth. Other trainers (e.g., T-4 and T-1) provide individual training, but WST tactics training provides crew discipline. Instructors can see differences between crews who have had significant WST tactics training and those who have not. Crews from units with a WST tend to have better crew coordination/integration. There is even some anecdotal evidence that crews with WST training are better prepared for Red Flag. There is a conscious use of the WST prior to major exercises/events, although this can be done effectively only by host units. The bottom line is that aircrews want more WST training, particularly if they are from units that do not have a WST.

The mix of independent and integrated training in the WST depends upon whether a unit is a host or not. Units that must travel to get such training tend to use the simulator solely in an integrated mode. At host units, they tend to use the WST more often and can afford to use it for independent training as well. Therefore, they tend to split the time about 50/50 between integrated and independent training.

The quality of WST scenarios varies from unit to unit. The 379 BMW has developed a multitude of EWO and conventional scenarios. TDY units tend to use available scenarios, and so they can be limited by what the host unit has developed. For example, the 320 BMW ends up using CCTS scenarios, which are basically representative of stateside training. They need more complex scenarios. TDY units would like to have the capability to develop their own scenarios, in order to support their specific EWO profiles.

TDY units have a number of problems with WST training. One is simply the logistics of scheduling and transporting crews and instructors. Scheduling sufficient numbers of instructors as well as crews is difficult. To add to this, travel restrictions sometimes limit the number of instructors that a unit can send to a WST site. For example, the 2 BMW has space limitations on the commuter aircraft that they use to transport their crews, which limit them to two instructors per trip. This means that they have to depend on the host unit to supply additional instructors, and additional instructors are not always available.

TDY units also do not have the option of changing scheduled events. The 2 BMW crews receive WST training 2-3 times per year. Because the requirements are for four EWO and four conventional sessions per year, they must accomplish a minimum of four "sorties" per visit. Four sorties are really too many to absorb in a 2-day trip. There is not sufficient time for effective review, critique, and retraining, given the tight schedule. Therefore, crews do not derive maximum benefit from their exposure to the WST. In addition, there is no trainer for radar navigators/navigators other than the WST. This presents problems for local upgrades and training in general. Some type of trainer is needed for procedures practice and for certification. Apparently, the 436 STS is working on computer-based courseware to address this need. Finally, TDY units tend to receive WST training during unpopular hours (e.g., nighttime and weekends) in some cases. This has negative effects on the aircrews' perceptions of WST training, as well as on the effectiveness of such training.

The WST also suffers from some hardware/software limitations. There are notable reliability problems, and the trainer tends to break during complex scenarios. There is a lack of switchology for conventional operations, and the trainer lags behind the aircraft in software updates. There are no visuals for fighters, and units cannot add their own visuals. In the area of malfunctions, there are distinct differences as to how the WST and the aircraft systems are reconfigured in such situations. At the defensive station of the WST, the lack of motion is a problem during integrated sorties. It is frustrating to call for a maneuver and not to be able to get motion feedback to tell if it has been accomplished. This generates unnecessary communications in tactics scenarios. In the aircraft, the EW and gunner would have nonverbal feedback as to whether the pilot responded to their call. The navigator station of the WST has a limited amount of motion which provides this feedback. With the emphasis on tactics training in the WST, this deficiency should be readdressed. However, due to the high cost involved in installing motion systems under the defensive stations, lower-cost alternatives providing "token cues" would seem to be the preferable option. Seat-mover/shaker systems or low-fidelity G-seat technology might be applicable.

The most notable system design problems seem to arise, however, at the EW station. The WST suffers from lack of reprogrammability. Signals cannot be readily changed to keep the system up to date. Signal quality is not as high as in the AN/ALQ-T4. This leads to problems in signal interpretation for EWs who have been training in the T-4. Both trainers have unique capabilities which make them useful. The T-4 serves as an effective signals trainer and has the advantages of rapid reprogrammability, reliability, and availability. The WST is clearly superior to the T-4 for crew tactics training.

Despite its limitations, the WST is generally perceived as an effective crew trainer. Host units tend to use it frequently and take advantage of its availability to provide training above and beyond the minimums required by regulations. TDY crews like the training that they receive, but they wish that they could get more frequent exposure. They would also prefer that the training be tailored to fit their specific mission requirements. Short of acquiring more WSTs or moving existing devices to other locations, the application of lower-cost training devices to supplement WST training may be the most effective answer to such unit needs.

Academics

Currently, units have limited or no capability at all to generate their own instructional materials. Therefore, they must depend on the 436 STS, which develops the majority of curriculum materials for continuation training. However, there is currently no way of establishing priorities for the 436 STS, in that there is no broad perspective on the overall needs of the Command for these materials. Many organizations request work from the 436 STS without going through HQ SAC/DOT, which is responsible for tasking them. This leads to additional confusion over priorities. In addition, the 436 STS lacks sufficient personnel resources for developing and updating materials. Despite the interest in such materials, there are also no regulations that require units to use products from the 436 STS.

On the positive side, the 436 STS is now working to field computer-based training materials for a number of applications. As mentioned earlier, CBT should play a key role in the future in providing training in such areas as systems operation, malfunctions, and tactics. This is particularly important for units that do not currently have an appropriate trainer, or when the existing trainer is not current with the aircraft. One of the most critical examples presently is the courseware mentioned earlier to support radar navigator/navigator training on OAS operation.

At the unit level, the variety of missions and procedures with which crews must be familiar results in little available time for completing ground training requirements. Much of this training

is accomplished on alert. Overall, there is really too much for the individual crewmembers to accomplish. "No time in the schedule" is a reality. The alternatives are to reduce the current load or to increase the efficiency of current training. CBT may offer some aid in this area, as it can be used in a self-study mode and reduce the stress on scheduling for classroom instruction.

E. Evaluation

This section addresses the evaluation of individuals and aircrews, and evaluation of unit aircrew training programs. Some suggestions for making evaluation more combat-oriented are also presented. Only the more salient evaluation issues are discussed.

Evaluation of Individuals and Aircrews

This section will focus on three issues: (a) the training information that is sent with CCTS graduates to the gaining units, (b) the evaluation of CCTS graduates by the units, and (c) assessing the proficiency of flying and combat skills during continuation training. The latter—assessment of aircrew proficiency—is one of the most pervasive problems in aircrew training evaluation.

Information from Phase I training at the CCTS can be beneficial in structuring early flying training at the gaining units. At present, CCTS graduates arrive at the units with training folders that contain copies of training accomplishment reports and progress records. Although these records are useful for determining the events and corresponding levels of proficiency accomplished at the CCTS, a common critique is that they are not very useful for designing individual flying training programs. They do not convey enough information about graduates so that gaining-unit instructors can develop a "picture" of the graduate's entering level of competence. Although existing information may be amplified through informal contacts with CCTS squadron commanders, what seems to be required is some type of profile in which commentary is provided about an individual's capabilities in critical skill areas such as air refueling, bombing, and ECM activity. Strengths and weaknesses could be described. This approach would furnish more prescriptive information from which to structure training at gaining units.

The units complete special evaluation questionnaires concerning new crewmembers at the conclusion of Phase II training. This evaluation, which is part of the CCTS external evaluation program, is designed to assess the extent to which the CCTS has prepared its graduates to perform certain job skills at gaining units. The evaluation is completed at the end of Phase II, for by that time instructor/evaluators have had the opportunity to observe new crew members on at least 2 to 3 flights. External evaluation questionnaires must be completed by graduates and gaining-unit squadron commanders. The CCTS is also supposed to conduct needs analysis visits to the gaining units, but it is unable to do so very frequently due to insufficient resources. Although there is a fairly high rate of return of the external evaluation questionnaires to the 93 BMW, some major problems were detected in the implementation of this evaluation mechanism. Most importantly, the units do not conduct systematic, performance-based evaluations of CCTS graduates. These evaluations occur on an informal basis only, and results from them are typically not documented. In the absence of thorough job performance evaluations conducted with reference to established proficiency criteria, the quality of feedback to the CCTS may be seriously compromised. The maxim here is that the quality of CCTS external evaluation is dependent upon the quality of gaining-unit internal evaluation.

Additional information from gaining units suggests that the questionnaires should be redesigned to evaluate each crew position more specifically. Some units also question the relevance of some items on the questionnaires. One potentially useful approach to constructing questionnaires might be to involve representatives from the gaining units in selecting appropriate targets for

evaluation. This would necessitate a consensus on CCTS training requirements and exit performance levels. One important area for more in-depth evaluation is the extent to which the CCTS prepares its graduates to perform mission-oriented skills. Training at the CCTS occurs in the context of an EWO mission, and the curriculum also contains some tactics and conventional familiarization training. Therefore, it is important to determine if this training produces some efficiencies, or savings, in similar types of training at the gaining units.

Perhaps the most significant challenges for developing effective evaluation methods are in continuation training. This is partly due to the way in which the current flying and ground training programs are structured. An implicit assumption of the training regulations is that Phase III is intended to *maintain* the knowledge and skill proficiency acquired in the previous two phases of qualification training and the level of crew proficiency assigned by unit squadron commanders. The Phase III training program is then uniquely designed on the basis of this logic. There are set numbers of repetitions for each training event which must be completed during each training period. The maintenance of proficiency is then *assumed* if the required numbers of events are completed throughout the training period. It is interesting to note that in the transition from Phases I and II to Phase III, the construct of proficiency is transformed from a dependent variable—where the number of repetitions to attain proficiency is expected to vary across individuals—to an independent variable, or a *fixed requirement* in the training regulations. The fixed requirement applies to all individuals who are assigned to the same training table, regardless of whether this number may be insufficient or excessive relative to attaining actual proficiency. The data collection or accounting system for Phase III is then derived from the logic of the continuation training program. Crewmembers simply record the number of repetitions of each training event on individual and crew mission accomplishment reports. The total number of repetitions per training period must match those required on an individual's assigned training table. It then becomes the function of the SACR 60-4 evaluation to serve as a "check" on whether aircrew proficiency is actually maintained in Phase III.

More is involved in continuation training than the maintenance of proficiency, however. In fact, crewmembers continue to improve aircraft operation skills initially acquired at the CCTS, and they develop new skills, particularly those required to perform the unit mission(s), throughout continuation training. Copilots and navigators continue to learn as they serve a type of apprenticeship to aircraft commanders and radar navigators until they are eligible for upgrade training. Crews also develop mission skills as they participate in special missions and deployments, pull alert, receive tactics and Phase II conventional training, and participate in ORIs.

Because the present accounting system for continuation training lacks provisions for recording proficiency levels, the Command is basically unable to track and document the acquisition of increased proficiency in aircraft operation skills or the development of specific combat skills. Bombing and ECM activity appear to be exceptions, in that these scores are reported through separate databases. The inability to document the development of combat skills seems particularly critical. A similar argument was presented by the General Accounting Office (1986) in their review of SAC flying hour programs, but it was couched in economic terms. They indicated that the high cost of flying necessitates that the benefits received from additional flying hours, such as increased proficiency and combat capabilities, should be substantiated by objective data. It is also important to consider that the objective of the training regulations is "to direct sufficient training for individuals and crews to successfully complete the SAC EWO, conventional, operational, and training missions" (SACR 51-52, p. 1-1). Accordingly, aircrew proficiency must also be assessed during continuation training to ensure that program objectives are actually attained. The units do have other evaluation mechanisms, however, and these will now be assessed to determine their potential applicability to solving this problem.

Squadron commanders currently assign aircrews to proficiency levels—ready, experienced, and select. These ratings could shed some light on the development of combat capabilities, as they take into account the ability to perform the unit mission(s). The factors or capabilities

that enter into these ratings are unclear, however, or at least unspecified. Hence, they are of limited use in solving the problem. Data sets would also have to be linked to these various capabilities to provide an objective means of documenting their development and assigning overall crew proficiency levels. Instead, these proficiency ratings appear to be the products of an informal evaluation network that operates in most flying squadrons.

The backbone of the evaluation system for individuals is, of course, the SACR 60-4 evaluation. These evaluations do address some combat capabilities, in that mission-critical areas are included in them. But a common criticism of these evaluations by standardization/evaluation personnel is that they overemphasize tolerances, procedures, and "safe operation of the aircraft in a peacetime environment." These factors are critical, but the point is that SACR 60-4 does not tap into an extensive enough range of combat capabilities. These evaluations also stress individual skills, not performance of the mission per se. Wing evaluators and 1CEVG discussed extensively the trend toward increased combat training such as threat knowledge, tactics, and conventional operations. They indicated that as the mission and tactics are emphasized more, one departs from SACR 60-4 with its emphasis on tolerances and procedures. Hence, its usefulness as a combat evaluation must be seriously questioned.

It must also be understood that SACR 60-4 as an evaluation instrument is designed to detect adherence to minimum standards, and that these same standards apply to all crewmembers, regardless of their levels of experience. Accordingly, SACR 60-4 is not really designed to detect the improvement or expansion of capabilities beyond these minimum levels. In this sense, it is not a useful device for tracking the development of combat capabilities over time or as a function of experience. Different forms of this evaluation, each progressively more difficult and/or expansive in scope, would have to be constructed and then applied to individuals with progressively higher levels of experience. Tracking the development of combat capabilities would also require the collection and comparison of data in a longitudinal fashion. This is not typically done with most evaluations at present.

One potentially useful approach would be to adopt a two-tiered system of evaluation, one centered on aircraft operation and the other on combat capabilities, as in the FB-111 and C-130 communities. The current SACR 60-4 evaluation would then not have to serve a dual purpose, and a separate combat evaluation that taps a wider range of capabilities could be constructed. The combat evaluation could be implemented as part of the Tactics Training initiative, in order to conserve resources. A first step would be to develop a detailed specification of the combat capabilities required to perform the unit mission(s). The required capabilities should be specified for each crew position and the crew as an integral unit. These combat-mission capabilities would also have to be linked to a sufficiently broad range of conditions or circumstances, as the conditions of actual combat would be expected to vary. Some of these conditions are alluded to in the EWO and conventional training objectives in the 51-series regulations.

A key concept in this proposed evaluation schema is precise control over the conditions of the evaluation. Because this is possible in a WST, it is suggested that the WST be used as an evaluation device in addition to a training device. Depending upon the capabilities of the WST, one could vary geographical features, weather, threat types and number, targets, and other conditions to construct a large, diverse set of high-fidelity mission scenarios, both EWO and conventional. This would be in marked contrast to the familiar, relatively static conditions of the typical evaluation sortie.

Another important aspect of the proposed evaluation schema is to construct a sequence of mission scenarios that vary in their overall level of difficulty. By exposing an individual or crew to a diverse set of mission scenarios progressively ordered in difficulty, one could then begin to establish the *upper limits* of mission knowledge and skills. One could easily argue that this is the critical information to have about aircrews. This approach also seems more consistent with the notion of assessing combat *capabilities*, especially when compared to the current

approach which assesses whether *minimum levels* of performance are attained under a limited range of conditions that may also be less demanding. In essence, the approach would permit broader and perhaps more valid generalizations about the capabilities of aircrews to perform in combat. Individuals and crews could be assessed at frequent intervals, and the results could be retained in a database. This database, analyzed as a time series, could then serve as a means of documenting the development of combat capabilities over time. The information could also be useful in developing more precise training programs for the acquisition of additional or new capabilities, in that the "end-point" of existing capabilities would be more clearly defined by the evaluation procedures. Finally, this database could also serve as a potential means to document some of the benefits received from training, which is the domain of program evaluation.

Evaluation of Unit Training Programs

The previous section dealt with the evaluation of individuals and aircrews. Information from these evaluations is important to a squadron commander, for example, who must make decisions about the mission capability of his aircrews. In this section, the emphasis shifts to evaluation of the program itself. Program evaluation usually involves a determination of the extent to which a program, or set of programs, is effective and/or efficient. In general, program evaluation includes a detailed specification and assessment of the program variables (resources, activities, and methods); evidence of their implementation; and a linkage to actual outcomes, which are typically expressed as aggregate measures of individual and crew performance. Other system-level measures, such as throughput per unit of time, may also be of interest. These outcome measures are typically compared to program objectives, or the intended outcomes, to arrive at an overall judgment of program effectiveness. Information from program evaluation may then be used in a variety of ways. Two common uses are to improve program performance and to demonstrate the actual benefits received from training. The General Accounting Office (1986), in its review of SAC's flying hour program, was clearly concerned with the latter issue—in this case, the benefits received from increased levels of flying, as flying hours are very expensive.

Although these two functions of program evaluation need not be mutually exclusive, it is our observation that SAC has emphasized evaluation for program improvement and falls short in demonstrating the benefits received from training. This is most apparent from an inspection of the reports of the reliability panels for bombing and ECM activity, and the Standardization/Evaluation Review Panel. The information contained in these reports is mostly a detailed listing of knowledge and performance deficiencies for individuals or aircrews. Though this kind of information is necessary to improve training and provide remedial instruction for individuals, it says very little about the overall effectiveness of training or the benefits received. This must be demonstrated in the affirmative through an analysis of aggregate measures of performance.

Although some wings do report overall percentages of reliable activity, such as bombing, which is a step in the right direction, this type of information is needed over a much broader range of skill areas, including aircraft operation and other combat capabilities. More detailed information could also be provided, for example, by analyzing distributions of bomb scores, rather than simply reporting whether bombing was reliable or unreliable. As indicated previously, the accounting system for continuation training cannot be used for documenting the benefits received from training either, as only frequencies of event completions are recorded. This is a measure of program implementation or how much training has been received; but, though it is a necessary measure for program evaluation, it says very little about the effectiveness of training.

According to SACR 51-52 (p. A1-2), there are other evaluations that the Command uses to determine the validity of the flying training program. These include ORIs, Global Shield, 1CEVG, HHD special exercises, and safety data. Though these may be important indicators of unit-level and Command program effectiveness, units have chosen superior crews to perform in these exercises in the past. Although we would certainly condone this practice in actual conflict or

wartime situations, it does pose some hazards for inferring that a unit's training program, which affects *all* crews, is valid or effective. One cannot rule out selection as a factor in the quality of performance exhibited during a special exercise. The observed performance may be due to the fact that the crew is superior; it may say nothing about the proficiency of a typical, or representative, crew within a wing. Accordingly, the performance may not necessarily be attributed to the training program per se. A random-sampling procedure would be more appropriate for this type of evaluation. In addition, although evaluations such as the ORI, special missions, and Global Shield are critical and should be included in a hierarchy of effectiveness evaluations, they are also relatively infrequent snapshots of unit and Command capabilities to perform the mission(s). They also involve a relatively small number of aircrews, regardless of how superior the aircrews may be. Ultimately, one must assess the impact of day-to-day training operations on *all* aircrews within a unit. This would also provide more detailed information about individual, crew, and unit capabilities on a continuing basis; and it would also prove more useful in documenting the benefits received from training.

There is currently no field-tested methodology for evaluating an entire aircrew training system that can serve as a model for other training system evaluations. A test and evaluation plan (see Spears, 1986) was developed as part of the C-130 Model Aircrew Training System study, and component-level and system-level evaluation issues were enumerated in the Statement of Work for the C-130 Aircrew Training System (Aeronautical Systems Division, 1986). Though these documents provide important source materials for devising an evaluation strategy, they have not been implemented in practice. Although conceptual efforts are likely to advance the art of aircrew training evaluation, the greatest effects will probably result from conducting evaluations of complex training systems in the field. A critical area of concern is personnel resources. If the Command is to conduct effective evaluation programs in the future, it must acquire personnel with expertise in planning and implementing evaluations of complex systems. Proficiency in data analysis/interpretation and proficiency in the analysis of training systems are also critical prerequisites.

F. General Issues

This subsection is concerned with three sets of general issues that emerged during the course of the review. Although they have been discussed to some degree earlier in this report, they are considered to be of sufficient importance to warrant consolidation and restatement. The first set of issues concerns with the process of identifying, validating, and controlling training requirements; the second set concerns with the accomplishment of selected training management support functions such as scheduling, recordkeeping, and reports generation; and the third set

concerns with the impact of personnel shortages, crew turbulence, and the decreasing level of aircrew experience in the rated force.

Training Requirements

The overriding impression at each of the units visited was that the units and the individual crewmembers were "awash in a sea of requirements," all competing for the same set of scarce resources. The primary driver for the consumption of flying hours appeared to be the frequency and currency requirements of the 51-series regulations. In addition to the burden of "chasing" 51-series events, there were also additional taskings in the form of new programs such as the Tactics Training, Conventional Training, and Airmanship initiatives. There were also a variety of other requirements imposed by HQ SAC, the NAFs, and the Air Divisions, without any apparent coordination or consideration of the overall impact on the local units. It was the impression of the reviewers that most of the units visited were saturated with requirements and were extremely busy trying to stay afloat.

As noted previously, personnel at the unit level appeared to be extremely enthusiastic with respect to many features of the new initiatives. For example, they indicated that the recent focus on tactics and conventional missions added a new dimension of realism, excitement, and esprit to their training because of the increased emphasis on "warfighting" and "crewmanship" skills. However, they were also concerned with the impact of these new programs on their ability to meet established training commitments. They indicated that they were already overloaded trying to satisfy all of their current requirements, and every new initiative appeared to be an "add-on"—nothing ever seemed to go away. Some reservations were also expressed with respect to the logic and economy of implementing "ancillary" requirements (e.g., touch-and-go's and aerodynamics), which seemed to be based on isolated accidents or incidents rather than general deficiencies or trends.

In view of the requirements saturation, there appears to be a critical need to establish a centralized mechanism within the Command to manage the requirements validation, prioritization, and approval process. Thus, when a new requirement is proposed, it should first pass the test of relevance, perhaps in terms of an assessment of its potential contribution to overall combat capability. It should then be prioritized relative to other existing and approved requirements. Then, the impact of its introduction on the ability of the affected units to meet their other commitments should be made. Finally, if the new requirement is judged to be of sufficient benefit, it should be approved and implemented on the assumption, of course, that it may sometimes be necessary to relieve the units concerned of the responsibility for meeting one or more of their other commitments. In the case of the 51-series requirements, the view was frequently expressed that the units could do a much more efficient job of utilizing local resources in meeting *individual* training needs if they were allowed greater discretion in determining "when" and "how" a particular event/task needs to be practiced to maintain an acceptable level of proficiency.

A corollary issue in the requirements area is the role of CCTS: That is, what skills and knowledge should CCTS graduates have when they report to their gaining units in order to optimize their development to combat-ready crewmember status? As noted in subsection A, gaining-unit personnel had somewhat different expectations concerning the kinds and levels of skills and knowledge desired. Some said that they would like to see deeper systems knowledge; others wanted an increased conventional capability; and others said, "Teach them to fly the airplane, and we will teach them to fight." What the CCTS product *should* be in order to best satisfy overall Command requirements is not intuitively obvious. However, what does seem obvious is that in order to design an optimal entry training phase, it is necessary to adopt the approach recommended by the third Board of Visitors report. That is, in order to design an optimal CCTS program, it is necessary to "look at SAC's entire training program as a system and require that the training system for B-52/KC-135s be a 'cradle to grave' training system approach... Under this approach, analysis of the continuation training requirements would better define CCTS training goals" (BOV, 1986).

Training Management Support

There is considerable variability in the extent and quality of computer applications to support the scheduling, recordkeeping, and reports generation at the various units. Development of the various flight schedules is still largely a very labor-intensive process, although some of the units visited do attempt to use their available small computer capability to perform some of the functions required. However, both the amount and capability of these applications appear to be largely a function of local talent, interest, and initiative. Although it is unlikely that generation of the near-term (weekly/ daily) schedules can be completely automated, increased application of available computer capability to the overall flight schedule development process could reduce the amount of manpower required to accomplish this function. In view of this potential payoff,

it would be highly desirable for SAC to explore the feasibility of selecting, or developing, a standardized scheduling support program for application at the local units.

The same variability among units noted in flight scheduling was also observed in the management of training data. There was also a variation in the quality of support provided by the base computer systems which host the Air Force Operational Resource Management System (AFORMS) data. For example, at one of the bases visited it was noted that there was as much as a 10-day delay in getting hard-copy reports and other paper products from the base computer. In addition, this same unit noted that there was also a quality control problem with respect to getting back the proper numbers. In one quality control check, they detected a 50% error rate in a set of sortie counts returned by the base computer. On the other hand, the DOT at the 2 BMW stated that they had no problem with access to the base computer at Barksdale. However, it was noted by the responsible person that they needed a more user-friendly database management system for data retrieval. He indicated that the available system, which was originally designed for the old Phase III base computer, required considerable programming skill to obtain the outputs desired. He also noted that the Data Design Center at Gunther was working on a "deployable" AFORMS program which could be downloaded to a small computer. Most of the units utilized their available small computers to augment and back up the base-level systems for the storage and retrieval of training data. Again, relative quality and effectiveness of the applications varied from unit to unit. However, most of the units did make some use of their small computers and optical mark readers. It would probably be useful for SAC to explore the feasibility of developing or selecting some cost-effective, standardized software for utilization at the unit level.

Personnel

The most frequent comments volunteered by the units were related to concerns over personnel shortages, crew turbulence, and lack of experience in the rated force. Despite the hard crew concept, turnover rates of 30% to 70% were cited for the year preceding the review. In the case of pilots, it was noted that requirements for B-1 manning, plus the ready availability of airline jobs, had resulted in the loss of some of the most experienced personnel. It was also noted that, because of the personnel shortage, navigators were being upgraded at 400 hours rather than 1,000 hours of experience as in the past. Shortages and lack of experience in other crew positions were also mentioned. Finally, for rated officers in the peacetime force, the requirements of the Air Force Officer Professional Development Program (AFR 36-23) appear to preclude a career in the cockpit (U.S. General Accounting Office, 1987). The active force is not like the airlines, where flying is *the* career and where most crewmembers relentlessly grind out about 1,000 hours of flight time year after year until retirement at age 60. Except for the Reserve and Guard, there probably are no 10,000-hour military pilots in active flying billets. In addition, perhaps as a testimony to the effectiveness of deterrence, there are few, if any, combat veterans in the active force to transmit their "lessons learned" and wisdom to less-experienced crewmembers.

Peace is hardly a deficiency, but the current peacetime environment with its concurrent resource limitations does place a greater burden on the training community to ensure that both the realism and efficiency of training are maximized. To respond to decreasing experience levels, training must be designed to speed up the acquisition of expertise by individuals and crews. Suggested ways to address this and other research and development issues are discussed in the following section.

G. Research and Development Issues

In order to develop a highly proficient combat force within current budget and personnel constraints, it is critical to get the most training possible for the available investment dollars. This can be accomplished by (a) applying the best available and affordable training technology to address the problems noted in the previous sections, and (b) conducting research and development (R&D) to devise and evaluate new or improved technologies/methodologies that address some of the key problems for which no completely satisfactory solutions currently exist. In this second area, the Aircrew Training Research Division is currently working on a number of relevant R&D programs. The following paragraphs describe four programs that are in support of or relevant to SAC and address needs identified earlier in this report.

For decades, SAC has assigned integral crews to aircraft on the assumption that a permanent crew structure would facilitate the development of crew coordination and enhance mission performance. In the past, most crew coordination skills developed in a relatively informal way as crewmembers gained experience working together and evolved their own particular style of functioning as an effective team. However, the personnel shortages, crew turbulence, and lack of experience noted previously have placed a greater premium on identifying ways of accelerating the development of such team skills. In recognition of this need, HQ SAC/DOT has recently initiated a program to identify and implement some form of aircrew coordination training (ACT) for all SAC aircrews. The value of such training has gained wide acceptance in the civilian sector. Most major airlines have instituted Cockpit Resource Management (CRM) training programs to promote good crew communication/coordination behaviors, on the assumption that this will lead to improvements in safety of flight and overall mission performance (Povenmire, 1989).

Despite the intuitive appeal of the CRM concept, most of the reports of its successful application in the airlines are anecdotal. There is little, if any, compelling empirical evidence that good CRM will enhance mission performance. In addition, even if such data were available for transport operations, their generalizability to SAC bomber operations would still require verification because of the critical differences in mission complexity, crew composition and duties, and levels of crew experience. It is difficult to measure relative mission success in commercial transport operations, as most missions are relatively routine and straightforward, and most flights land on-time with the correct number of passengers, regardless of how well the crew interacts. Many B-52 operational combat missions, on the other hand, are extremely complex and involve very heavy workloads which require extensive crew coordination among the six highly specialized crewmembers in order to ensure survival and mission success. The Aircrew Training Research Division has initiated some research in support of SAC, and this research is to determine the applicability and potential effectiveness of formal CRM/ACT training for facilitating the development and maintenance of crew coordination skills for SAC aircrews. Although this research program is still in its formative stages, the initial findings appear to be very promising (Povenmire, Rockway, Bunecke, & Patton, 1989).

As mentioned earlier, the current evaluation system within SAC is significantly limited with regard to providing critical information for training management and resource justification. The problems here run the gamut from a lack of effective measures of aircrew performance, particularly in the area of combat skills, to the absence of aggregate measures of system performance, which are critical for allocating and defending training resources. The Division has worked closely with SAC in the past on the development and evaluation of objective measures of aircrew performance, leading to implementation in some cases. Recently, the focus has shifted to the development of more comprehensive methods to support the evaluation of aircrew training systems. Bruce (1989; in preparation) has completed reviews of the information and evaluation systems associated with Phase I training at the 93 BMW, and Phase II and Phase III training at the 92 BMW. These studies provide insights into the types of training information that are currently collected, how the information is used, and the limitations of the current system. They suggest the need for more effective and efficient collection, distribution, and management of

training system information, and they provide a basis for identifying key areas for evaluation R&D. These endeavors complement ongoing efforts to develop and validate evaluation techniques in the context of the C-130 Aircrew Training System. Together, they should provide guidelines for the application of enhanced evaluation methodologies to training systems.

With the growth in interest and applications of total training systems, especially contractually developed systems, there is a need for information to guide design and implementation. A number of such training systems have been implemented, such as the C-5 and KC-10 programs; however, no attempt has been made to date to document the lessons learned from these programs. The Division is now working to develop and demonstrate a database to capture this information (see Rockway, 1988). This database would aid program developers and managers in the identification and effective integration of training technologies, information systems, and management tools.

Finally, the continuing reduction in overall experience in the crew force poses a serious challenge to trainers. To compensate, we need to develop a means for accelerating the acquisition of expertise. Concepts emerging from research on the development and retention of knowledge and skills may provide some answers to this problem. Research on topics such as skill automaticity and expert versus novice performance have suggested ways to facilitate skill acquisition and to identify key features of expert performance that must be trained. We are currently conducting a review of the state of the art in this area, which will provide the basis for the development of an R&D program to test the applicability of these concepts to aircrew training.

CONCLUSIONS AND RECOMMENDATIONS

Several central themes emerge from this study. Foremost among these is the pressure on the units to optimize the allocation of limited training resources to an expanding number of training requirements. The general feeling at each of the units visited was that they are overburdened with frequently uncoordinated requirements which compete for a limited pool of resources. There appears to be a critical need to establish some centralized mechanism within the Command to manage the requirements validation, prioritization, and approval process. When new training requirements are implemented, there must be some means for prioritizing them and, in some cases, relieving the concerned units of responsibility for meeting one or more of their existing requirements. This is symptomatic of the more general need to consider all three phases of training as part of a total training system. Whether intended or not, changes in the requirements for any individual phase have an impact not only on existing requirements and resources for that phase, but on the other phases as well.

Related to this is the need to clarify the requirements for initial qualification training, to ensure that the graduate is adequately prepared for mission qualification, but within the time and resource constraints of the CCTS program. The units are generally satisfied with the quality of CCTS graduates. They also acknowledge that the 93 BMW has a difficult job turning out a product that is fully acceptable to all units, particularly since the range of mission taskings is increasing throughout the Command. CCTS cannot address all their needs; so, units differ on how CCTS resources should be spent. Without a commonly accepted definition of what CCTS training requirements are or should be, CCTS becomes a target for additional requirements to facilitate the transition of aircrews to combat-capable status.

Third, although the recent emphases on tactics and warfighting skills are welcomed by the in-unit crew force, initiatives such as Tactics and Conventional Training have been introduced as add-ons to an already heavy training load. There has been no corresponding reduction in other training requirements or the provision of additional training resources. This has led to difficulties in qualifying crews in these areas, particularly when the training is not specified as

an event or set of events in the flying training regulations. Because of these problems, the new initiatives have had, in some cases, reduced priority compared to existing requirements. This training is particularly problematic for those units which do not have their own WST, as the WST plays a central role in such training. In addition, the Tactics Training program appears to be somewhat fragmented and uncoordinated. There is virtually no standardization of tactics programs across units. It is also unclear to the units as to who has overall responsibility for the program. Some of these problems could be addressed via the clarification of management responsibilities and requirements, provision of standardized supporting materials, and the introduction of new technologies for training some aspects of these tasks.

Fourth, a conscious effort is required to determine effective and efficient approaches to the allocation of training resources, focusing on optimizing the use of individual media and downloading requirements from the overburdened flying schedule to alternative devices. The aircraft is still the principal (and most expensive) training resource, but the competing demands for it exceed the available amount of flying time. The amount of flying time per se is not considered the problem; rather, it is the prioritization of requirements relative to this medium and the availability of range assets to provide effective training environments. Units report that simulators, such as the WST, are effective training resources, but such simulators are limited in number. They are also subject to hardware/software limitations, currency problems, and scheduling constraints, which have in some cases become quite serious. The 436 STS is responsible for continuation training courseware, but the demand for these materials far exceeds existing resources to produce them. Embedded training technologies and microcomputer-based training tools appear to be promising avenues for addressing some of the limitations on training assets. Better training management tools, such as computer-assisted scheduling, may facilitate the effective use of all these media as well.

Fifth, the lack of effective methods for proficiency assessment, particularly for combat skills, has consequences not only for the evaluation of individuals and aircrews, but for the evaluation of the training system itself. The current accounting system for flying training is a byproduct of an event-based training system. It provides a means to document the accomplishment of training only. Proficiency is currently inferred from the numbers of event accomplishments which correspond to given training tables. There is no formalized proficiency assessment device for use during training. As a result, the units are unable to document the development of combat skills which, ultimately, are necessary for mission accomplishment. The existing SACR 60-4 checkride evaluates some critical mission areas, but it is not particularly suited to the evaluation of other combat skills, such as tactics. It is also constructed to assess minimum levels of skills, not upper limits. Assessments of the latter are necessary to have more valid indicators of combat capability and to structure rigorous training programs to extend combat capability. The development of suitable methods for evaluating individuals, aircrews, and the training program is necessary, particularly with regard to documenting the benefits of resource expenditures (e.g., flying hours). Effective evaluation will also require an investment in personnel resources and supporting technologies, such as computerized management information systems.

Finally, R&D is needed to devise new or improved technologies to address some of the key problems for which no completely satisfactory solutions currently exist. The Aircrew Training Research Division has worked with SAC in the development of the B-52/KC-135 CCTS Modernization Program, the development and evaluation of Cockpit Resource Management training, and the application of advanced microcomputer-based training to the development of aircrew tactical decision-making skills. Additional research initiatives that should be of interest to SAC include improved methods for the evaluation of individuals, aircrews, and training programs; development of a lessons learned database for aircrew training; evaluation of an embedded training capability; and a review of the state of the art in development and retention of higher-order skills and expert performance.

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